

Insect farming and consumption in Australia - opportunities and barriers

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ABSTRACT

This paper explores the potential for a viable industry in Australia for the production of insects for human consumption. The findings are based on a literature survey of the current use of insects as a food resource globally, as well as on interviews conducted with various specialists with knowledge in the field of entomophagy (the practice of eating insects).

Key words: entomophagy, food production, insects, culture, diet

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Kerry Wilkinson, an Associate Professor at the University of Adelaide, is an oenologist (specialist in wine making) by training but her research of late has taken a different direction. Wilkinson has started investigating whether or not Australians will eat insects.

She is not alone in this interest. In recent years, insects have appeared on the menus of a small number of high-end restaurants across Australia. The appearance of insects as a food source is occurring across the Western world. "Insects, often sold as street food in the developing world, have become gourmet in the West" (Ramos Elorduy 2009).

You could dismiss this as the latest food fad but societies across large parts of the non-Western world have practised entomophagy for thousands of years and many continue to do so. In Thailand for instance, the rearing of crickets for human consumption is a "widespread commercial activity," with farms producing up to 750 kg of crickets in a harvest cycle of 45 days (Nadeau 2015).

The United Nations Food and Agriculture Organisation (FAO) is backing the idea as well. A broad-based effort is underway at the United Nations FAO to examine the multiple dimensions of insect gathering and rearing as a viable option for alleviating food insecurity (Van Huis *et al.* 2013).

The European Union is currently funding a research project (PROteINSECT) which, while initially focussed on developing insects for animal feed, aims to "encourage the evolution of a positive...platform for the utilisation of [insects]...as human food in the long term" (website 2016). PROteINSECT is collaborating

on research with non-EU countries: China, Mali and Ghana. In the United States, thanks in part to a Mexican influence, edible insects are a growing niche industry. This is evidenced by the range of edible insect start-ups like Rainbow Mealworms, San Diego Wax Worms, SmallStock Foods. One American start-up, Chapul is producing approximately 900 kg of crickets a month for conversion into flour to produce energy bars, and they note that their market is growing every month (Crowley pers. comm. 2015).

However, entomologist and editor of *The Journal of Insects as Food and Feed*, and Associate Professor at La Trobe University, Dr Alan Louey Yen, notes that (despite Aboriginal people having a long history of entomophagy), "Australia is a long way behind the rest of the world in this area...the idea hasn't really taken off" (pers. comm. 2016).

Australia's premiere public scientific research body CSIRO, while housing the world's largest collection of Australian insects, is currently not conducting any research into edible insects (CSIRO pers. comm. 2015). Furthermore, Australia has only one food grade producer of edible insects, the Edible Bug Shop, run by entomologist Skye Blackburn. The company produces approximately 800 kilograms of crickets per month and approximately 400 kilograms of mealworms (Blackburn pers. comm. 2015). Reflecting the small scale of their operations, prices are high (a 200g packet of cricket protein powder costs \$40)

Why does this even matter? Do we really need to eat insects? The United Nations FAO propounds the view that the rearing of edible insects (as opposed to traditional

livestock) for human consumption could be one of the keys to reducing our environmental impact, as well as to feeding a global human population, which is set to expand to nine billion by 2050. (Van Huis *et al.* 2013).

This is because, being cold blooded, insects in general are much more efficient converters of their ingested food to body weight than livestock such as, cattle, pigs, sheep and chickens (Van Huis *et al.* 2013). Crickets, as one of the types of insects most commonly eaten, need only 2 kg of feed for every 1 kg of bodyweight gain (Van Huis *et al.* 2013). This means they need $\approx$ 12 times less feed than cattle, four times less feed than sheep, and half as much feed as pigs and chickens to produce the same amount of protein (Van Huis *et al.* 2013). This obviously has significant environmental advantages in terms of the amount of land required to produce their food and therefore to raise them. Additionally, many insects require little actual living space and in fact can be effectively raised in warehouse-like conditions, in cages stacked on top of each other (Blackburn pers. comm. 2015).

While many insects are reputed to taste good, importantly they also generally have a very good nutritional value with regards to proteins, fats, lipids, vitamins, minerals and salts (Ramos Elorduy 2009). Dung beetles and palm weevil grubs are known to contain high levels of calcium, while termites and caterpillars contain high levels of iron (Gahukar 2011).

Therefore, eating insects arguably makes very sound environmental sense. There is a caveat here of course - it depends how we go about it. While many traditional cultures have harvested insects from the wild, the mass harvesting of insects could disrupt sensitive ecosystems (Louey Yen 2010). Stable, constant insect supplies could be difficult to obtain from wild populations, as many insect species naturally go through boom and bust periods (Van Huis *et al.* 2013). Harvesting from the wild also places humans in direct competition with other species (Van Huis *et al.* 2013), such as small mammals, birds, reptiles and amphibians as well as many invertebrates including other insect species.

The alternative is of course domesticating and rearing insects. Thailand, as previously mentioned, already has a thriving edible insect industry with more than 20 000 insect farms registered across the country (Hanboonsong *et al.* 2013). But Thailand is a rarity. Thailand has channelled funds into research to support and improve the industry and the country has the added bonus of having a culture in which insects are routinely eaten, with many insect species such as weaver ants, bamboo caterpillars *Omphisa fuscidentalis* and giant water bugs *Lethocerus indicus* recognised as a delicacy and sold at numerous markets across the country (Hanboonsong *et al.* 2013).

While Aboriginal people have a long history of entomophagy, most Australians have an aversion to eating insects. This is despite happily consuming other arthropods such as prawns, lobsters and crabs¹. We tend to associate insects with disease, or to see them as a last resort to avoid starvation (Louey Yen 2010). Obviously this aversion to eating insects is a significant barrier to the development of a viable edible insect industry.

This Western aversion is also becoming a barrier to people of other cultures continuing to consume insects. Western dietary preferences are highly influential globally, with traditional diets, which include insects being abandoned for the Western diet, which is perceived as socially superior (Shelomi 2015). The authors of a report into edible insects in Thailand say part of the blame for insects being dismissed as a food source lies with the Western media and their negative portrayal of entomophagy (Hanboonsong *et al.* 2013). Entomophagy is practised less by Aboriginal people today than it was 100 years ago due in part to their increasing adoption of European diets (Louey Yen 2010).

So can we make ourselves like the taste and experience of eating insects? This brings us back to the research by Kerry Wilkinson. She recently conducted a survey of 204 people asking them a series of questions designed to understand the willingness of consumers to be adventurous with novel foods such as insects (Wilkinson pers. comm. 2015). While some people are very willing to try new foods, (neophiles), and others are very reluctant, (neophobes), most of us fall somewhere in the middle. Not surprisingly, the results of her survey found that a high proportion of people who were identified as neophiles had tried insects or were willing to try them and a significantly lower proportion of those who were identified as neophobes had tried, or were willing to try insects (Wilkinson pers. comm. 2015). Significantly, the survey results found that if insects *no longer looked like insects*, respondents found them more appealing. Wilkinson's survey found that respondents were certainly open to eating insects in a biscuit or flour but they did not want something looking back at them. An increasing number of creative entrepreneurial companies around the globe are working around this Western squeamishness by completely disguising the original product. These inspired start-ups are rearing insects or insect larvae, grinding them up into powder and baking them into biscuits, breads, pastas and energy bars. They are also making them irresistible by coating them in chocolate!

But working around this Western aversion, through product innovation, is only one of many hurdles the

¹ When grasshoppers and cicadas are boiled they turn red just like crustaceans (Shelomi 2015).

industry has yet to overcome if it is to transition from niche start-up to widespread commercial success and thereby have a significant impact on food security.

On the face of it, Australia, with its insect friendly climate and advanced scientific organisations, is in a good position to raise insects. We also have indigenous knowledge as an important information source to draw from. However, many of the moth and beetle types of insects traditionally eaten by Aboriginal people, namely witjuti grubs, (larvae of several moth species) bardi grubs (larvae of many different beetle species) bogong moths *Agrotis infusa* and honey pot ants are slow growing and therefore not suitable for farming in comparison with fast growing species such as crickets (Louey Yen pers. comm. 2016). Skye Blackburn of the Edible Bug Shop has experimented with culturing witjuti grubs and bogong moths but found them not viable from a commercial standpoint, e.g. witjuti grubs can take up to five years to reach edible size (Blackburn pers. comm. 2015).

The number and types of Australian insect species suitable for consumption, domestication and large scale production is as yet unknown, and using non-native species would come with the attendant bio-security risk to native ecosystems of these insects becoming introduced pests.

Dr Jenny Ekman is a research scientist with the agricultural research company Applied Horticultural Research. She has conducted research into the breeding of black soldier flies *Hermetia illucens* for the aquaculture industry and she notes that the breeding of insects, even for animal consumption, encompasses many different fields including biochemistry, farming, nutrition and marketing of the whole supply chain. It also doesn't fit easily into funding categories ...it seems a bit more out there as a concept and there's no guarantee of success" (Ekman pers comm. 2015). It is no doubt partly for these reasons that insect consumption is yet to hit the mainstream consciousness in a big way.

Like any industry, a regulatory framework needs to be developed. Alan Louey Yen observes that in Australia people are uncertain about the legality of using insects as food (pers comm. 2016). Edible insects in Australia are governed by the Australia New Zealand Food Standards Code and fall under the category of 'novel food'. While the European organisation PROteINSECT has investigated the current regulation and legislation around insect production/consumption, Australia has no such organisation to undertake this work. Currently, two law students, under the direction of Louey Yen, are researching the legislative aspects of commercial insect production in Australia (Louey Yen pers comm. 2016). This research hopefully will contribute substantially to the development of a viable industry.

Another hurdle to overcome is the shortage of technical knowledge about the optimum rearing conditions for individual insect species. Insects, as a group, when compared with vertebrate animals, are poorly studied.

In order to be considered suitable for domestication, insects must meet a host of criteria including being easy to breed in captivity, having a high growth rate and requiring a diet that is easy to replicate in an artificial setting (Van Huis *et al.* 2013). Appropriate insect species also ideally would favour high population density environments (to allow for mass production in minimal space) (Van Huis *et al.* 2013).

The manner in which we rear insects also raises some interesting animal ethics questions, namely can insects feel pain? The science remains uncertain on this. Insects are known to possess nociceptors, which are the sensory systems that respond to noxious stimuli and mediate protective reflexes. However, nociception is not analogous with feeling pain (Ellwood 2011). Given their size, it is not feasible to kill insects individually as we do with cattle or pigs. Current methods for killing insects include freezing, sun-drying and boiling or frying live insects. As Australia generally has very stringent animal care and ethics regulations in relation to domestic livestock and native wildlife, more intensive use of insects as food and associated insect farming operations could open another whole 'can of worms' in terms of industry regulation.

One plus in terms of animal ethics is that many insect species can be bred in cramped, crowded conditions without this impacting on their welfare. As Founder of Chapul –American cricket energy bar company, Pat Crowley notes, "Crickets are a good fit for farming - they prefer dark, high density environments, as long as there is a readily available food supply" (Crowley pers comm. 2015).

Louey Yen believes that a significant reason why edible insects have not taken off in Australia is because we have such large agricultural resources to draw on – there is less pressure to think more creatively about alternative food sources (Louey Yen pers comm. 2016).

However, as a wealthy country, Australia arguably has an ethical and environmental responsibility to develop environmentally sustainable food production, both for our domestic consumption and for the export market. Insect farming could help us do this if we so choose.

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APPENDIX I

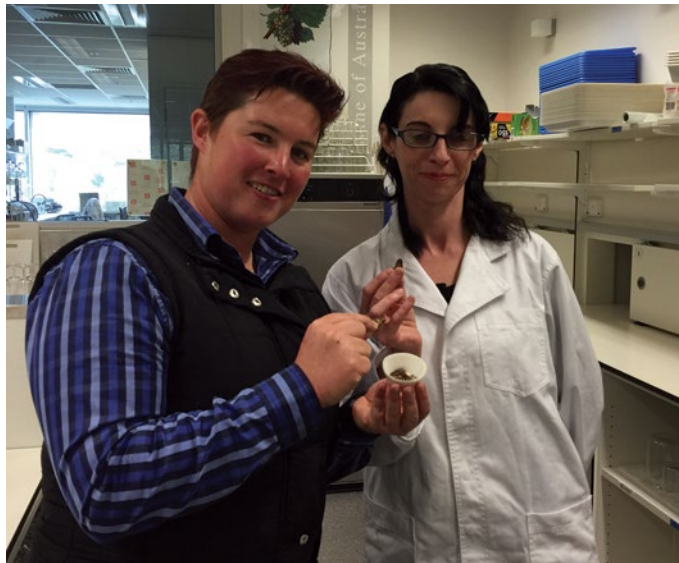


Wilkinson's edible insects prepared as part of the research into consumer attitudes. Credit: University of Adelaide

APPENDIX I



Australian witjuti grub. Credit: Dr Alan Louey Yen



Wilkinson (on right) and Honours student Crystal Bayldon in the lab. Credit: University of Adelaide



Woman working at Thai insect farm. Credit: Dr Alan Louey Yen.